

Plains Grassland and Plains Forest Ecotype



Figure 22. Plains Grassland and Plains Forest Ecotype

Montana's high eastern plains, part of America's Great Plains, are generally found on high, rolling land and on some scattered hills and in wide river valleys. Some of the rivers in this region, particularly the warmwater sections of the Yellowstone and Missouri in eastern Montana, harbor the most diverse communities of fish in the state. It's a rather harsh environment, with short, hot summers and long, cold winters that bring fewer than 15 inches of precipitation a year. In this environment, the protection offered by woody draws and the unique badlands or "breaks" provide important pockets of habitat and protection for wildlife.

In addition, Montana's unique prairie forests, found in the blistered "island" mountain ranges east of the Rocky Mountains, provide a higher elevation relief where precipitation is sufficient to create closed-canopy forests of Great Plains ponderosa pine and various hardwoods. Although these forests are not islands in the true sense, they are a unique part of the plains landscape.

Grassland

Landscape Characteristics

The plains grassland and plains forest ecotype includes 43,918,691 acres and represents 46.7 percent of Montana. Elevations at the western and southern edges of the plains grassland and plains forest ecotype range between 3,500 and 4,000 feet. Elevations decrease gradually toward the northeast, where the lowest point, 1,900 feet, as the Missouri River exits Montana, is reached. Broad areas less than 2,500 feet lie near the lower Missouri and Yellowstone rivers. For the most part the land is flat or rolling. Steeper dissected topography is found in

various badland areas of the east and southeast and in river breaks areas near the Missouri and Yellowstone and some major tributaries. Two major rivers, the Missouri and the Yellowstone, cross the entire ecotype. Flowing into these rivers are various large tributaries including the Milk, Marias, Powder, Tongue, Bighorn, and Musselshell rivers, all crossing many miles of the plains grassland.

Most of the area north of the Missouri and a little of it to the south, was overridden by the continental glaciers, creating topography that is somewhat smoother and flatter than the plains to the south. Exceptions to this are areas near some of the major rivers where erosion following glaciation dissected the land. Glaciated plains tend to have a relatively large number of small, poorly drained depressions, some of which form potholes or small lakes.

Soils

All soils in the plains grassland ecotype are classified as cool (average annual temperature ranging between 32 and 47 degrees F). Much of the soil in the glaciated plains (approximately north of the Missouri River) part of the ecotype contains large amounts of salt and may also be alkaline. Such soils may be medium textured with distinct topsoil horizons, or they may be heavy clay soils without horizons. The second-largest category of soils in the ecotype includes those that have light-colored topsoil layers and are not particularly saline or alkaline. These soils may or may not have lime layers. Places with somewhat higher effective precipitation (due to greater precipitation and or/ lower evaporation) have dark, well-developed topsoil horizons with a distinct clay layer just beneath that. These tend to be the most fertile and most easily tilled soils in the ecotype.

Climate

The climate of the plains grassland ecotype can be generally characterized as semiarid—cold in winter, warm in summer, and highly variable compared to the remainder of Montana. During much of the winter, Canadian high pressure pushes cold air south over the region. This type of weather pattern produces extremely low temperatures that may persist for days or weeks at a time, as well as low precipitation since moisture-producing weather systems are subsequently routed south. During the summer, low pressure caused by high temperatures may draw moisture in from the Gulf of Mexico. The area is mostly outside of the primary track of Pacific moisture-producing storms except for a period during late spring to early summer.

Mean annual temperatures range from 38 degrees F in some areas in the extreme northeast to 48 degrees F at some places south of the Yellowstone River. The mean for the ecotype is somewhere around 43 to 44 degrees F. Mean January temperatures vary from 2 degrees F in the northeast to 21 degrees F in the south. Mean July temperatures range from 63 to 72 degrees F. The highest

temperatures are along the Yellowstone River, whereas the lowest are in the northwest where the ecotype abuts the intermountain /foothill grassland ecotype. Minimum yearly temperatures upon which plant hardiness zones are based range from minus 38 degrees F in the northeast to minus 24 degrees F in the south. The boundary between hardiness zones 3 and 4 (mean minimum yearly temperatures in the minus 30s and minus 20s respectively) follows a line going approximately from the southeastern corner of Montana to the Sweetgrass Hills. There is no zone 5 in this ecotype. Mean annual maximum temperatures range from 104 degrees F along the lower Yellowstone River to 95 degrees F at the highest elevations of the ecotype in the northwest.

Average annual precipitation in the ecotype ranges from 10 inches in a wide band along most of the highline and a south-central area to 16 inches in some scattered eastern and southern areas. The average for the ecotype is from 12 to 14 inches. Except for some widely scattered isolated areas, the eastern portion of the ecotype tends to receive a greater proportion of its precipitation in the April 1 to July 31 (growing season) period than the west. Except for an area in the northwest, western areas near the mountains receive less than 55 percent of the precipitation in the April to August period, while most areas in the east receive more than 60 percent.

Snowfall ranges from 21 to 40 inches throughout most of the area. The higher snowfalls occur in the portions of the ecotype closest to the mountains. A few isolated areas in the extreme east get less than 20 inches of snow per year. The mean number of days per year when there is at least 1 inch of snow on the ground increases from the western and southern edges of the ecotype to the northeast. The areas with the least number of days of snow cover are in the Chinook zone, where extremely strong and persistent winds during the winter either sublimate or melt the snow. Mean wind speeds vary from 11 to 13 miles per hour over most of the ecotype. Days with snow cover range from less than 60 to more than 120 across the ecotype.

Anthropogenic Uses

The plains grassland ecotype encompasses the largest area in Montana. Recreational activities include hunting, fishing, and snowmobiling. Major industries includes ranching and farming, which produce some of the largest wheat and cattle yields in the country. The breakdown of landowner stewardship for the plains grassland ecotype is as follows:

U.S. Federal Agencies:	6,081,573 acres, or 13.8% of total area, which include:
BLM:	5,083,576 acres, or 11.6% of total area
USFS:	142,889 acres, or 0.3% of total area
USFWS:	716,050 acres, or 1.6% of total area
NPS:	556 acres, or less than 0.1% of total area
State Agencies:	2,886,994 acres, or 6.6% of total area

Tribal Lands:	2,532,892 acres, or 5.8% of total area
Private:	32,190,791 acres, or 73.7% of total area
City and County:	3,027 acres, or less than 0.1% of total area

Vegetation

On the semiarid plains grasslands, vegetation communities and soil characteristics are strongly associated. The rather uniform climatic conditions across the area dictate that differences in plant community composition are primarily due to the variations in available water-holding capacity of the soils. Soils are organized into categories that reflect annual precipitation as well as water-holding capacity. These categories, called ecological sites, are grouped on the basis of parameters such as texture, slope topographic position, and chemical characteristics. Most of the ecotype is within the 10- to 14-inch precipitation zone, and therefore, textural/topographic/chemical characteristics are the primary regulators of plant community composition.

Within the ecotype there is a relatively small number of grass species that occur as dominants throughout the area. Some of these are found in various amounts in nearly all the communities, whereas others are more specialized and occur only under certain conditions. Other major changes in the grassland communities occur with human management because of differing responses of species to management treatments. In addition to dry land farming, which totally removes native vegetation, range management practices impact native species.

Vegetation found throughout the ecotype includes western wheatgrass (*Agropyron smithii*), needle-and-thread (*Stipa comata*), bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), prairie junegrass (*Koeleria macrantha*), green needlegrass (*Stipa viridula*), thickspike wheatgrass (*Agropyron dasystachyum*), fringed sage (*Artemisia frigida*), and dense clubmoss (*Selaginella densa*). Other widespread species common in certain conditions include little bluestem (*Andropogon scoparius*), prairie sandreed (*Calamovilfa longifolia*), silver sage (*Artemisia cana*), sun-sedge (*Carex stenophylla*), and threadleaf sedge (*Carex filifolia*). Most other grasses and grasslike plants are only minor community components or are dominants in very restricted areas (Ross and Hunter 1976).

In terms of biomass, forbs in plains grassland communities tend to be highly subordinate in most conditions. Certain subshrubs, including fringed sage, broom snakeweed (*Gutierrezia sarothrae*), and prickly pear (*Opuntia polyacantha*) may become dominant members of some communities following overgrazing. Varying amounts of shrubs occur throughout the plains grasslands. However, the areas where shrubs contribute a large and consistent proportion of the biomass have been included in the shrub grassland ecotype.

Patterns of species dispersal and precipitation distribution influence the distribution of some species throughout the ecotype. The bluestems (warm-season grasses) originated farther east in the plains region of the United States and generally do not penetrate much beyond the eastern third of Montana with its more continental pattern of precipitation distribution. Bluebunch wheatgrass originated in the intermountain region of the United States (Barker and Whitman 1988), where spring and winter are wet and summers are dry. Although it is abundant on most sites in the western part of the ecotype, it becomes progressively less abundant and more restricted toward the east. Western wheatgrass, another important plains species, decreases toward the west. The plains grassland ecotype is a zone where mixed prairie species meet some of the Pacific/intermountain bunchgrasses, although the area is primarily dominated by the former (Wright and Wright 1948).

Coarse-textured sandy soils (2 percent of the ecotype) have not had time to form soil cover. Widespread species favored by coarse-textured soils include needle-and-thread, little bluestem, silver sage, and threadleaf sedge (Ross and Hunter 1976) (Hansen et al. 1988). Some other species whose distribution in Montana is mostly restricted to, rather than just favored by, sandy soils, include sand and big bluestems (*Andropogon hallii*, *A. gerardi*), prairie sandreed, Indian ricegrass (*Oryzopsis hymenoides*), sideoats grama (*Bouteloua curtipendula*), and yucca glauca.

Medium-textured soils, described as silty, occupy the greatest (more than 70 percent) range within the ecotype. Silty soils have a good combination of relatively high water-holding capacity as well as high permeability and infiltration rates. Potential natural communities in medium-textured soils in the 10- to 14-inch precipitation zone are dominated by western wheatgrass and needle-and-thread. However, blue grama can become abundant enough during drought periods to become dominant on many sites. This suggests that plant communities in the northern Great Plains with its extreme and variable climate are not static but vary greatly over time. Culwell et al. (1986) sampled grasslands in extreme eastern Montana dominated by western wheatgrass, blue grama, and threadleaf sedge. Western wheatgrass and green needlegrass constitute most coverage with run-in moisture such as swales and footslopes. Bluebunch wheatgrass is a dominant in western areas with western wheatgrass and needle-and-thread becoming much less abundant. Subdominant grasses include prairie junegrass, blue grama, sun sedge, and sometimes thickspike wheatgrass. Plains reedgrass (*Calamagrostis montanensis*) and plains muhly (*Muhlenbergia cuspidate*) may be locally dominant in some western areas. Little bluestem is locally dominant in some areas mostly in the east. The most important forb genera include *Lomatium* and *Astragalus*. In addition to the common species of the rest of the plains grassland, the areas receiving between 15 and 19 inches of annual precipitation allows the establishment of some species for which the surrounding areas are too dry. These include big bluestem (*Andropogon gerardii*) and Idaho fescue (*Festuca idahoensis*). Some plant communities on medium-

textured soils have been altered by cultivation or long periods of heavy grazing. Heavy grazing increases blue grama, fringed sage, clubmoss, prairie junegrass, and cheatgrass (*Bromus tectorum*) at the expense of wheatgrass and sometimes needle-and-thread.

Fine-textured soil constitutes a little more than 18 percent of the ecotype and is less favorable to species like needle-and-thread, prairie junegrass, and blue grama, although they will likely persist if adequate topsoil exists and is maintained. The finest textured soils with little or no topsoil support mostly western wheatgrass, green needlegrass, thickspike wheatgrass, and bluebunch wheatgrass in central and western parts of the ecotype (Ross and Hunter 1976). The heaviest clay soils are also usually saline and possibly alkaline. Species not adapted to such conditions are prevented from establishing and are replaced by facultative or obligate halophytes such as western wheatgrass, saltgrass (*Distichlis stricta*), green needlegrass, Nuttall saltbush (*Atriplex nuttallii*), and greasewood (*Sarcobatus vermiculatus*). In low-lying areas, species favored by periodic flooding occur. These include Nuttall alkaligrass (*Puccinellia nuttalliana*) and alkali cordgrass (*Spartina gracilis*). Areas of fine-textured soils in the plains that receive greater (15 to 19 inches) precipitation than the rest of the area share many of the dominant species as the adjacent foothill regions as well as those of the rest of the plains ecotype. These foothill species include bluebunch wheatgrass and Idaho fescue. Big bluestem occurs in the easternmost areas.

Topographically complex areas in the plains grassland ecotype include the river breaks and badlands areas, which are difficult to categorize vegetationally. Bluebunch wheatgrass and western wheatgrass tend to be dominant grasses in most areas. Little bluestem, prairie sandreed, needle-and-thread, and green needlegrass may be locally abundant. Shrubs and conifers may be locally important, especially in the breaks. Common shrubs include big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), rubber rabbitbrush (*Chrysothamnus nauseosus*), aromatic (skunkbush) sumac (*Rhus aromatica*), snowberry (*Symphoricarpos occidentalis*), and Nuttall saltbush. Draws in the extreme eastern part of the ecotype provide habitat for certain woody species not normally found elsewhere except in the Midwest. The tree most commonly encountered is green ash (*Fraxinus pennsylvanica*). Quaking aspen (*Populus tremuloides*) is occasionally found, and bur oak (*Quercus macrocarpa*) occurs in drainages of the extreme southeast (Hansen et al. 1988). Chokecherry and snowberry are shrubs commonly found in these situations. Relatively small timber stands are found scattered throughout most of the breaks area. Both ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) occur in these stands as far east as 108.5 degrees longitude; east of this point Douglas-fir drops out. The occurrence of these conifer species in the breaks is due to topographic conditions since the area does not receive any more precipitation than the surrounding plains. A typical timber stand in the breaks forms a closed canopy consisting of ponderosa pine and Douglas-fir. The

understory shrub component is composed of some or all of the following: snowberry, aromatic sumac, chokecherry (*Prunus virginiana*), rose (*Rosa nutkana*), and Rocky Mountain juniper (*Juniperus scopulorum*). Frequent stand-replacing fires in the area result in communities composed of these shrub species but minus the tree overstory. Forbs and grasses include western yarrow (*Achillea millefolium*), aster (*Aster falcatus*), rose pussytoes (*Antennaria microphylla*), bluebunch wheatgrass, and plains muhly (*Muhlenbergia cuspidate*).

Forest

Landscape Characteristics

The plains forest ecotype includes 3,266,564 acres and represents 3.5 percent of Montana. Forested areas in the plains generally occupy higher areas that represent erosional remnants of resistant rock layers, particularly the Arikaree Formation near Ekalaka. These rock layers are younger than the layers supporting the surrounding grasslands (Ross et al. 1955). The stands of plains forest are located on hilly regions, mostly in the southern half of the plains portion of Montana. These hilly regions may be enough higher than surrounding grasslands, such that there is increased annual precipitation capable of supporting forests. Such hilly topography may also create topoedaphic conditions suitable for the establishment of tree cover. The difference in elevation between the forested hills and the adjacent grasslands is not great, generally in the neighborhood of a few hundred feet to at most 2,000 feet. Elevation differences much greater than this would generally result in a montane forest site. The forests of the Chalk Buttes, Longpines, and area near Hammond result from hills and/or buttes rising several hundred feet above base elevations of about 3,200 to 3,500 feet. The large forested area just east of Ashland occupies hills rising from low elevations of about 3,000 feet near the Tongue River to approximately 4,400 feet. The extensive forested region extending from near Custer through Lame Deer to Birney ranges in elevation from 4,000 to 5,000 feet. The lowest elevation of the Bull Mountains forested area is roughly 3,000 feet at points along the Musselshell River. Highest elevations are a little more than 4,000 feet. Most of the other scattered plains forest stands are due to elevation rises of a few to several hundred feet (e.g., east of Miles City, south of Rosebud, and north of Rapelje), topoedaphic effects (e.g., along the Yellowstone River near Columbus), or proximity to mountain areas (e.g., Longpines and Chalk Buttes).

Soils

The largest single category (80 percent) of soils occurring within the plains forest ecotype is described as having a relatively light-colored, thin topsoil horizon. Lime layers may be present if the parent material is calcareous. On the wettest sites (2.5 percent), the soil characteristics of montane forests are found. These tend to be acid with a duff layer (partially decomposed leaves, etc.) on top and a reddish brown clay layer beneath that. The remaining major category of soils is

the one where shale is the parent material.

Climate

The overall climate of the plains forest ecotype is determined by the same factors as the plains grassland, except that elevations of this ecotype are higher. These higher elevations have the effect of lowering temperatures and increasing yearly precipitation, allowing the establishment of forest.

Mean annual temperatures in the areas of plains forests generally are about 1 to 2 degrees F lower than the adjacent grasslands. In most cases this means temperatures from 43 to 44 degrees F. Since most of these are in the southern or western parts of the state, their annual temperatures are several degrees higher than at lower elevations in the northeast. January temperatures generally are 1 to 2 degrees lower than the surrounding grasslands, while July temperatures may be 3 to 4 degrees lower. This suggests that the slight differences in elevation have more effect on summer temperatures than winter temperatures.

Total annual precipitation over the entire ecotype averages approximately 14.5 inches. Some of the wettest areas receive more than 20 inches of annual precipitation. There does not appear to be any difference in the proportion of precipitation received during the growing season as compared to the adjacent lower elevation grasslands. Depending on exact location, May or June is the wettest month of the year and February is the driest.

The average frost-free season is typically shorter than that of the adjacent plains grasslands due to higher elevations and the reduction of overall temperatures. The frost-free season ranges from 90 to 115 days.

Anthropogenic

The plains forest ecotype is the smallest in landmass of the five major ecotypes. Recreational opportunities abound in these large pockets of forest. Activities include hiking, biking, snowmobiling, hunting, cross-country skiing, and wildlife watching. The primary industries in the area are livestock grazing, mining, and some timber extraction. The breakdown of landowner stewardship for the plains forest ecotype is as follows:

U.S. Federal Agencies:	547,647 acres, or 17.9% of total area, which include:
BLM:	156,850 acres, or 5.1% of total area
USFS:	390,797 acres, or 12.8% of total area
State Agencies:	155,059 acres, or 5.1% of total area
Tribal Lands:	285,716 acres, or 9.4% of total area
Private:	2,222,219 acres, 72.7% of total area

Vegetation

The plains forest ecotype occupies 4,610 square miles. The ecotype was intended to include only areas with relatively large contiguous tracts of potential forestland. The Missouri breaks woodlands are included with the plains grassland ecotype described earlier in this document. Because the plains forest areas are somewhat higher in elevation than the surrounding plains grassland, precipitation conditions (a combination of higher total amounts plus a favorable growing season wet moisture distribution) favor the establishment of a closed canopy forest.

Great Plains ponderosa pine (*Pinus ponderosa* var. *scopulorum*) is the sole conifer forming the plains forest ecotype, although various hardwood tree species (e.g., American elm [*Ulmus Americana*], green ash [*Fraxinus pennsylvanica*], American plum, [*Prunus Americana*], and bur oak [*Quercus macrocarpa*]) occur along some of the draws and ravines. In contrast to the ponderosa pine west of the Continental Divide, this variety tends to be shorter. Maximum tree heights range from 35 to 60 feet in dry situations and as much as 95 feet where there is more moisture (Arno 1979). Microclimatic conditions may be favorable in some places for Douglas-fir (*Pseudotsuga menziessii*), to establish, but apparently seed sources are too distant. The drier forests tend to be relatively open and support mostly grass understories. Grasses commonly found in these situations include little bluestem (*Andropogon scoparius*), big bluestem (*Andropogon gerardii*), bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), and threadleaf sedge (*Carex filifolia*). Moist forests contain understory species common to montane forests to the west. Species include Canada buffaloberry (*Shepherdia canadensis*), kinnikinnick (*Arctostaphylos uvaursi*), Oregon grape (*Mahonia repens*), twinflower (*Linnaea borealis*), heartleaf arnica (*Arnica cordifolia*), fairy bells (*Disporum trachycarpum*), wintergreen (*Pyrola secunda*), and false Solomon's seal (*Smilacina stellata*).